MANITOBA

**Environmental Management Division**
**Environmental Control Services**

# Environmental Control Programs

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# SOURCE TESTING FOR PARTICULATE EMISSIONS FROM THE INCINERATOR AT CARA AIRLINE SERVICES, WINNIPEG, MANITOBA 1984

Prepared by Environmental Control Services,
Department of Environment and Workplace Safety and Health.

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## ABSTRACT

On May 29, 1984, three particulate source emission tests were conducted on the refuse incinerator stack at Cara Airline Services. During normal incinerator operation, the average particulate concentration, at average stack $CO_2$ values was 0.089 grams per dry standard cubic metre (g/dscm). When the average stack $CO_2$ value was corrected to 12%, the average particulate concentration increased to 0.18[illegible] g/dscm. This value is below Manitoba Regulation 334/74, Clause 3(1) limiting particulate emissions from new incinerators to 0.23 g/dscm of dry flue gas when corrected to 12% $CO_2$.

## INTRODUCTION

In order to determine compliance with Manitoba Regulation 334/74, Clause 3(1) the Environmental Control Services conducted a stack sampling survey on the refuse incinerator at Cara Airline Services, Winnipeg International Airport. Although this company comes under federal jurisdiction, it is Federal Government policy for all establishments under their control to meet applicable provincial regulations. This policy is outlined in Section 3 of Environmental Protection Service Report EPS 1-EC-78-5.

A dual chamber incinerator, installed December 1982 at Cara Airline Services Winnipeg International Airport, is used to burn refuse from international commercial flights.

The 1983 particulate emission tests revealed that the Cara Airline Services incinerator was in non-compliance of Manitoba Regulation 334/74, Clause 3(1). After the testing program was completed in 1983, operating procedures were changed to limit the amount of excess air entering the incinerator. These modifications would (1) increase the percentage of $CO_2$ in the stack gas, and (2) limit the development of turbulent high velocity gases which could increase particulate emissions. This report documents the effects of these changes.

## PROCESS DESCRIPTION

A Pyro Thermtec Model HU-150 multiple chamber incinerator was tested for particulate emissions. Figure 1 depicts the incinerator as installed at Cara Airline Services. The primary and secondary combustion chambers are heated by auxiliary gas burners which are normally set to burn continuously for 4 and 4 1/2 hours respectively. When the secondary chamber reaches 149°C to 260°C (300° F to 500°F) the incinerator is charged with several bags of refuse, typically containing food, plastic, paper, metal cans and glass bottles from international flights. At two hour intervals the primary chamber is recharged, thereby controlling excess air. Drying, ignition and partial combustion of the refuse occurs in the primary chamber. Air intake to the primary chamber is reduced to control the combustion rate and temperature. This prevents turbulent gases from transporting ash particles into the secondary chamber. Complete combustion of gasified and partially combusted volatile components is completed in the secondary (afterburner) chamber. Air is supplied in excess of stoichiometric requirements to ensure complete combustion in this chamber.

The combustion products, carbon dioxide and water vapor, exit through a 7.3 m (24 ft.) steel stack. A 7.6 cm (3 in.) ceramic liner is installed as a heat dissipater. The stack has a continuous inside diameter of 42.4 cm (16.7 in.).

When the incinerator has cooled, ash is removed from the primary chamber.

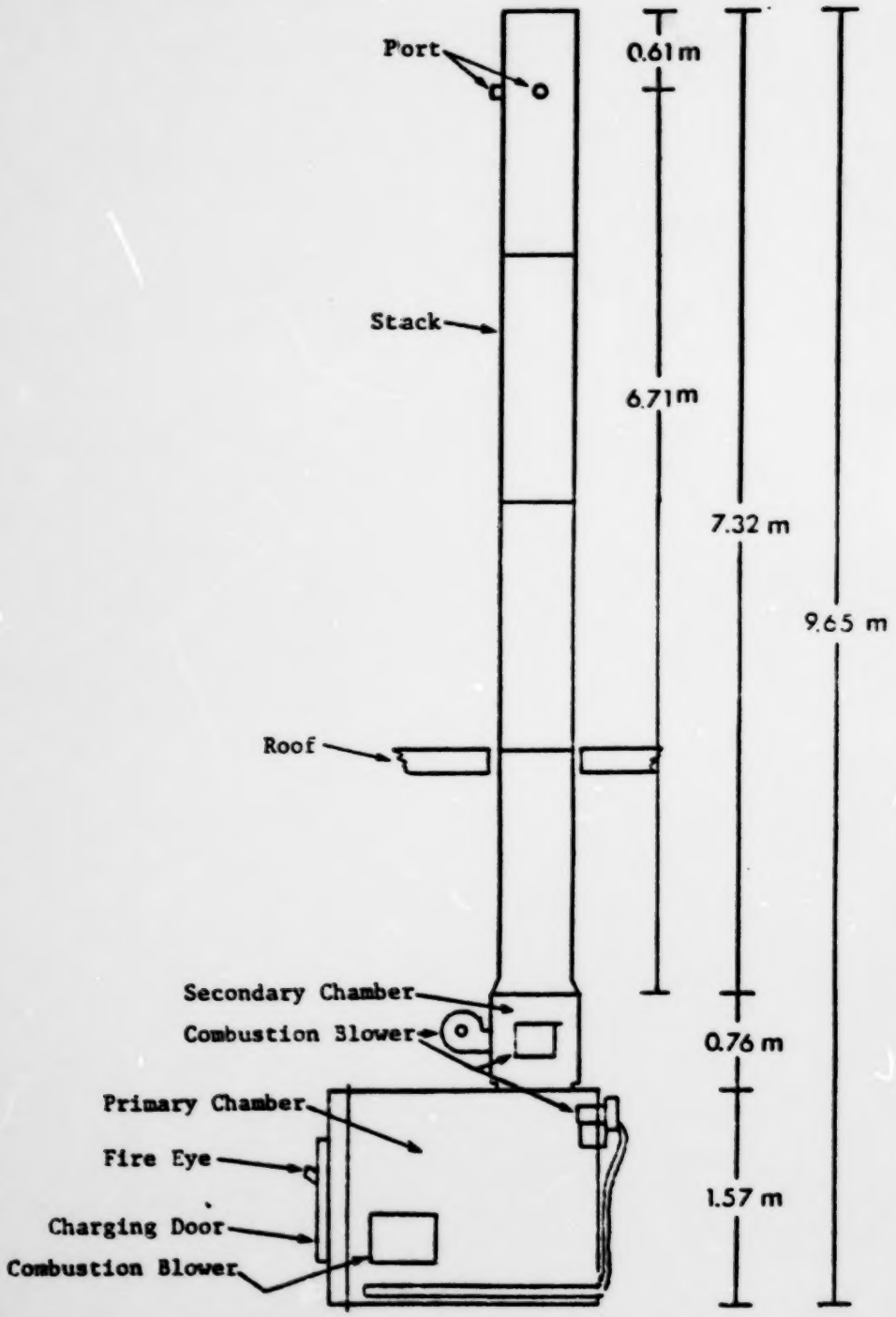



FIGURE 1. Pyro Thermtec Model HU-150 Incinerator as Installed at Cara Airline Services Winnipeg International Airport

## PROCESS SCHEDULE

The incinerator was charged on three occasions on May 29, 1984. At 9:50 A.M. the incinerator was initially charged with four large (66 x 91 cm) and 10 small (30 x 40 cm) plastic bags of wastes generated on international flights. Test 1 commenced at 10:30 A.M. and was completed at 11:24 A.M. At 12:05 P.M. the incinerator was charged with 22 small plastic bags. Test 2 commenced at 12:35 P.M. and was completed at 1:24 P.M. At 2:05 P.M. the incinerator was charged with an additional large plastic bag of similar waste from Cara Airline Services. Test 3 was conducted from 2:28 P.M. to 3:19 P.M.

## TEST PROCEDURES

All sampling was conducted through two 10 cm (4 in.) ports located at right angles to each other (south and east) 6.7 m (15.8 duct diameters) above the secondary chamber and 0.6 m (1.4 duct diameters) below the top of the stack. Four points were sampled along each traverse according to Environmental Protection Service (EPS) Method A Specifications. The sample points, located 2.8, 10.7, 31.8 and 39.6 cm from the stack wall, are depicted on a cross section of the stack in Figure 2. Sampling intervals were five minutes per point. Velocity profiles for tests 1, 2 and 3 are presented in Appendix A.

Source emission testing was conducted according to EPS Method E. Figure 3 illustrates the particulate stack sampling train. The sample was drawn into a 12.57 mm (0.495 in.) nozzle, through a 1 m stainless steel heated probe and into a miniature cyclone which removed particulate matter of greater than 10 μ diameter. The sample was then passed through a Whatman 934AH glass microfibre filter (supported by a porous fritted glass disc), which removed particulates of 0.3 μ diameter and greater. Both the cyclone and the filter were heated to prevent moisture from condensing at that point. The sample was then passed through four 500 ml Greenburgh-Smith impingers connected in series placed in an ice bath. The first, second and fourth impingers utilized modified straight tips while the second impinger was of the standard Greenburgh-Smith design. The first and second impingers contained 100 ml of deionized water. The third impinger was initially empty while the fourth was loaded with 200

grams of indicating silica gel. This gel removed any remaining moisture from the gas sample.

A Bendix Series 4500 Isokinetic Stack Sampler was used to extract the samples from the stack. Gas velocity in the stack was measured with an S type pitot tube and a Dwyer Model 2000-00AV Magnehelic Differential Pressure Gauge (range 0 to 0.25"$H_2O$, minor division 0.005"$H_2O$). Dry gas meter and pitot tube calibration data sheets are presented in Appendix B. A Hays-Republic Model 621A Gas Analyzer was used to determine $CO_2$, $O_2$ and CO content of the stack gas. Stack temperature was measured by a K type thermocouple.

After sample recovery from the stack train, samples were submitted to the W. M. Ward Technical Services Laboratory for gravimetric analysis of particulates.

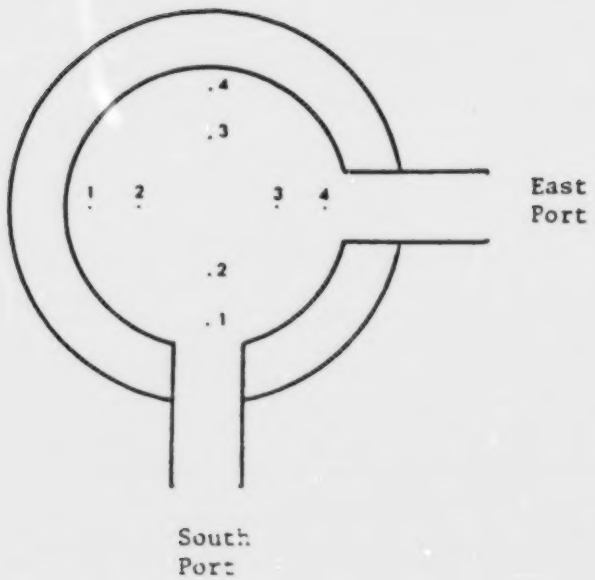



FIGURE 2. Cross Sectional Diagram of Stack Indicating Sampling locations.

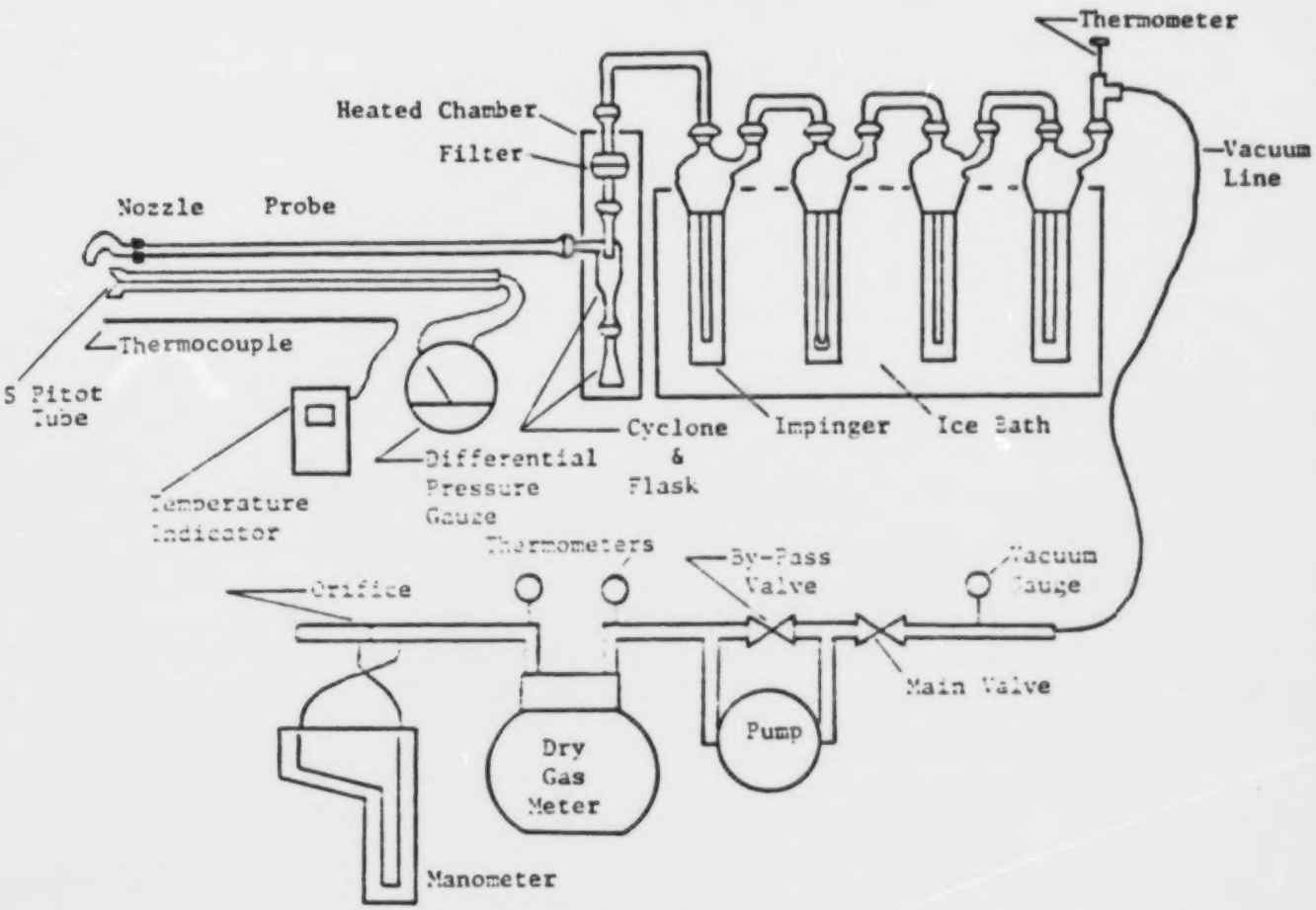



FIGURE 3. Particulate Stack Sampling Train

## RESULTS

Important sampling variables are summarized in Table 1. Refer to Appendix C for field data.

Source emission data are summarized in Table 2. The laboratory analytical reports are located in Appendix D.

TABLE 1: SUMMARY OF SAMPLING PARAMETERS

| TEST NUMBER | 1 | 2 | 3 |
|---|---|---|---|
| SAMPLING DATE | May 29, 1984 | May 29, 1984 | May 29, 1984 |
| SAMPLING DURATION, min. | 40 | 40 | 40 |
| SAMPLING VOLUME @ METER CONDITIONS, $m^3$ | 0.6017 | 0.6190 | 0.5685 |
| SAMPLING VOLUME @ STANDARD CONDITIONS, dscm* | 0.5880 | 0.5950 | 0.5443 |
| AVERAGE GAS METER TEMPERSTURE, °C | 28 | 33 | 34 |
| ORIFICE PRESSURE DROP, mm $H_2O$ | 25.9 | 26.0 | 22.4 |
| STACK STATIC PRESSURE, mm $H_2O$ | +1.14 | +1.14 | +1.14 |
| AVERAGE STACK GAS TEMPERATURE, °C | 571 | 593 | 596 |
| AVERAGE STACK GAS VELOCITY, m/s | 6.2 | 6.3 | 5.9 |
| ISOKINETIC FACTOR, % | 101.8 | 103.2 | 103.0 |

*Standard Conditions are 20°C and 760 mm Hg

TABLE 2: SOURCE EMISSION SUMMARY

| TEST NUMBER | | 1 | 2 | 3 | AVERAGE | |
|---|---|---|---|---|---|---|
| STACK GAS COMPOSITION DRY BASIS, % BY VOLUME | $CO_2$ | 5.0 | 6.6 | 6.6 | - | |
| | $O_2$ | 14.2 | 11.4 | 11.4 | - | |
| | CO | 0.4 | 0.0 | 0.0 | - | |
| STACK GAS MOISTURE % BY VOLUME | | 9.4 | 8.2 | 9.2 | 8.9 | |
| Ms**, g/g-mole | | 28.30 | 28.57 | 28.45 | - | |
| AVERAGE STACK GAS VOLUMETRIC FLOW RATE, dscm/h | | 983.4 | 980.3 | 900.6 | 954.8 | |
| CONCENTRATION OF PARTICULATE IN THE STACK GAS, g/dscm: | AT STACK $CO_2$ | 0.101 | 0.092 | 0.073 | 0.089 | |
| | AT 12% $CO_2$ | 0.242 | 0.167 | 0.133 | 0.181 | 1/ |
| EMISSION RATE OF PARTICULATE, kg/h | | 0.10 | 0.09 | 0.07 | 0.09 | |

** Molecular Weight of the Stack Gas on a Wet Basis

## DISCUSSION

Changes in incinerator operating procedures have increased $CO_2$ concentration in the stack gas; therefore reducing the particulate concentration when stack concentration of $CO_2$ is corrected to 12% $CO_2$.

Controlled air entry to the incinerator decreased turbulent gas flows which transport excess particulate matter from the primary chamber to the atmosphere. These operational changes ensure that the retention time in the secondary chamber is sufficient to burn off volatile matter.

## CONCLUSION

Compliance tests indicate an average particulate emission of 0.181 g/dscm when corrected to 12% $CO_2$ or 0.089 g/dscm at average stack $CO_2$ values. When corrected to 12% $CO_2$ the particulate emission is below the Manitoba Regulation 334/74, Clause 3(1) limit of 0.23 g/dscm.

The particulate emission rate is 0.09 kg/h.

## BIBLIOGRAPHY

1. "Air Pollution Guidelines Applicable to Incinerators at Federal Establishments", Report EPS 1-EC-78-5, Environmental Impact Control Directorate, Environment Canada, August 1978.

2. "Incinerator Design Standards: Research Findings", Publication No. 60, Air Pollution Control District, County of Los Angeles.

3. "Report on Winnipeg International Airport Incinerator Design Study", Underwood McLellan Ltd., March 1979.

4. "Source Testing for Particulate Emissions from the Incinerator at CARA Operations Ltd., Winnipeg, Manitoba, 1983", Environmental Management Division, Air Pollution Control, Province of Manitoba, 1983.

5. "Standard Reference Methods of Source Testing: Measurement of Emissions of Particulates from Stationary Sources", Report EPS 1-AP-74-1, Air Pollution Control Directorate, Environment Canada, February 1974.

APPENDIX A: Velocity Profiles

APPENDIX B: Equipment Calibration Data

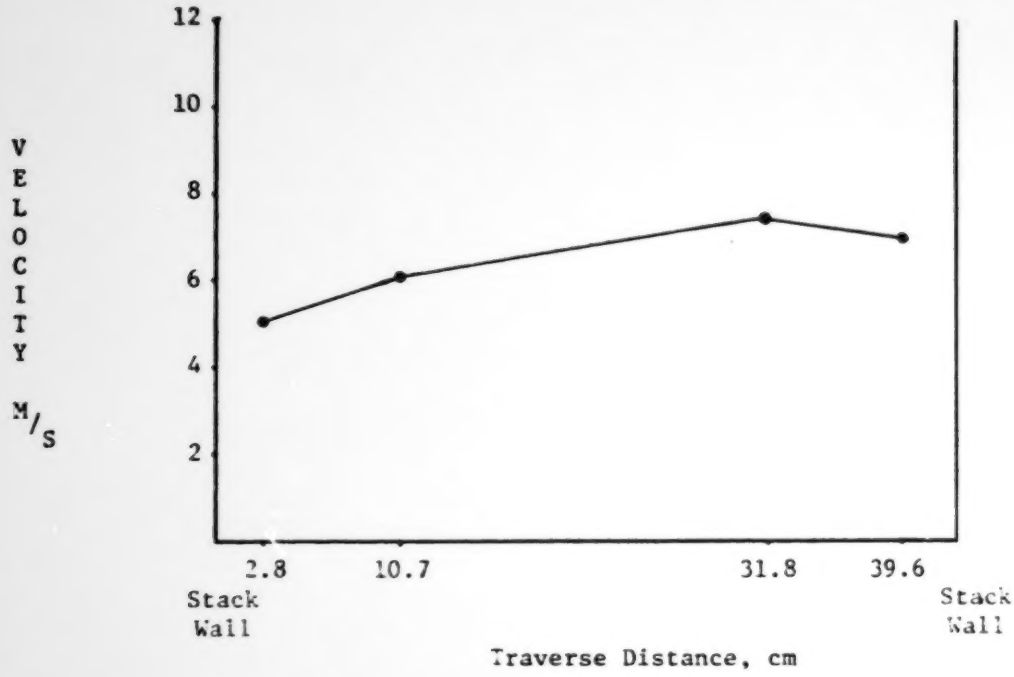
APPENDIX C: Field Data Sheets

APPENDIX D: Analytical Report

# APPENDIX A: VELOCITY PROFILES

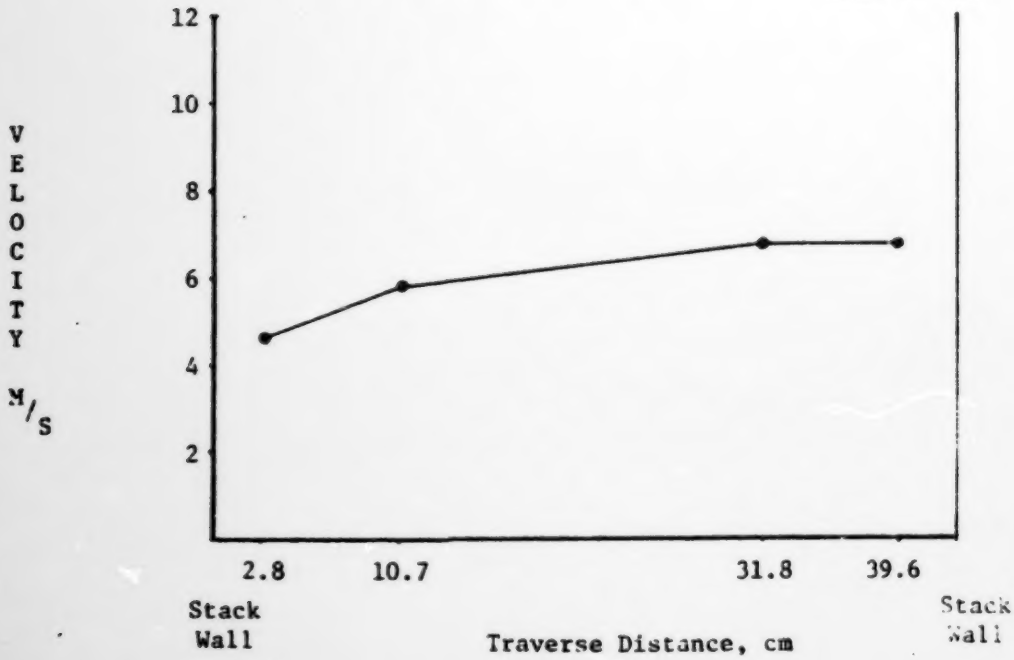
Graph 1 . Velocity Profile of Test 1 , East Port.

Wind 32 km/h South



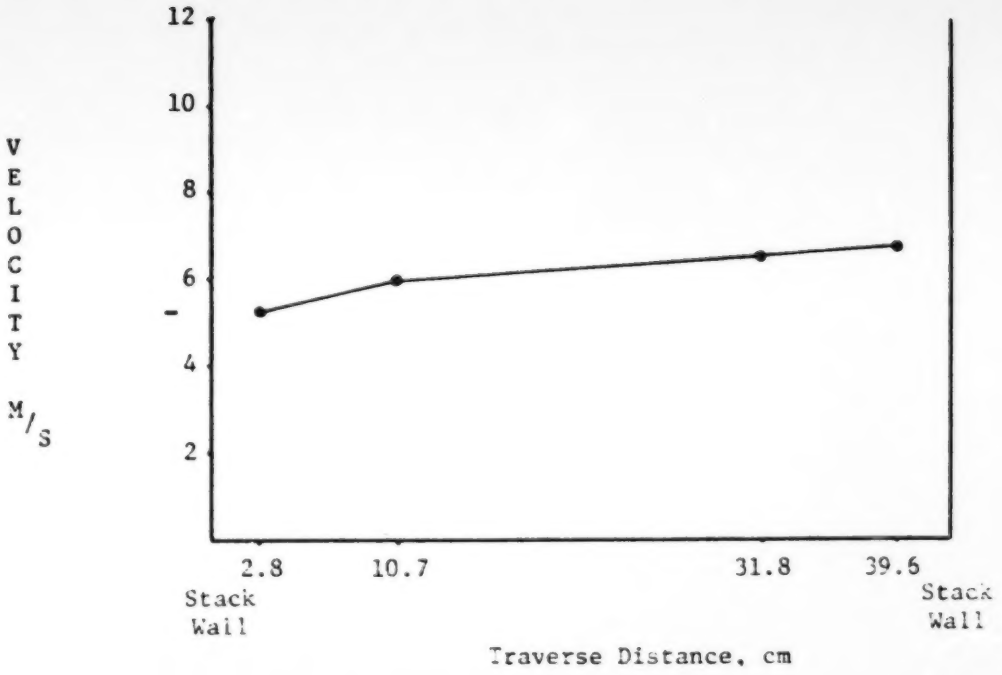

Graph 2 . Velocity Profile of Test 1 , South Port.

Wind 32 km/h South



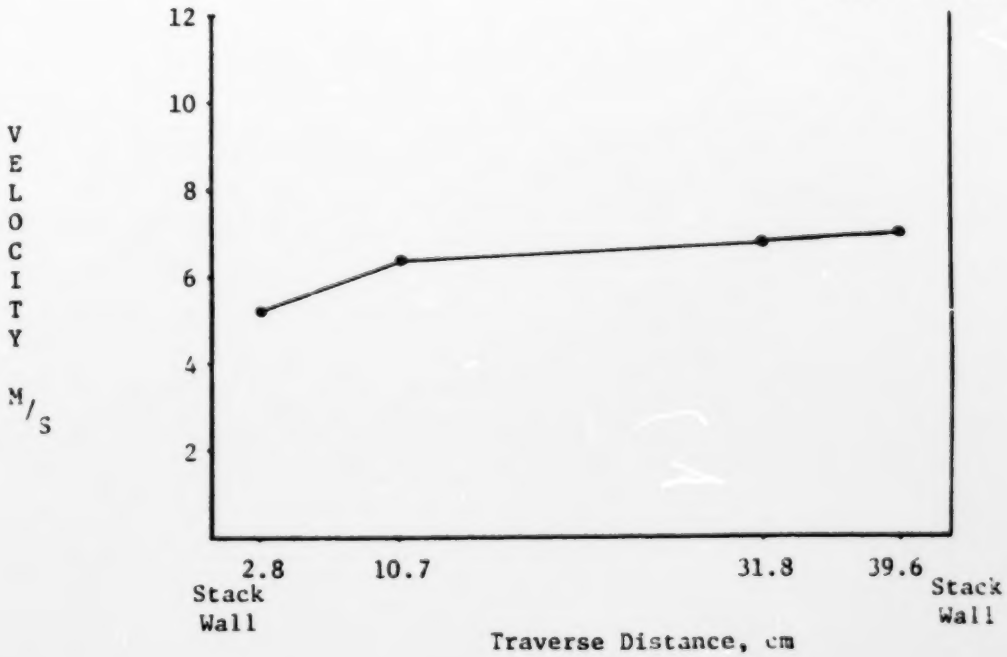
Graph 3 . Velocity Profile of Test 2 , East Port.

Wind 32 km/h South

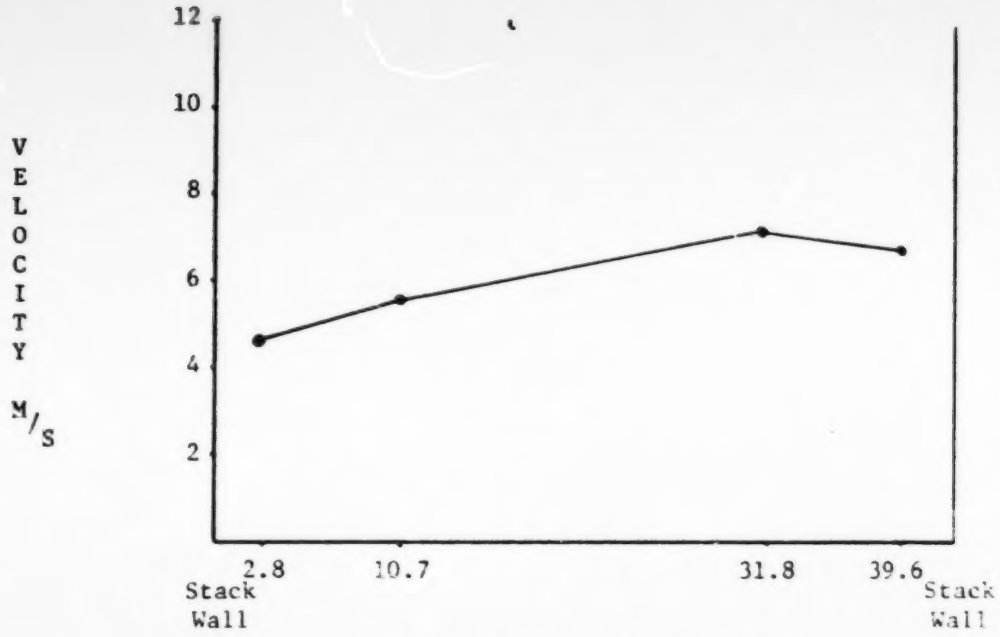



Graph 4 . Velocity Profile of Test 2 , South Port.

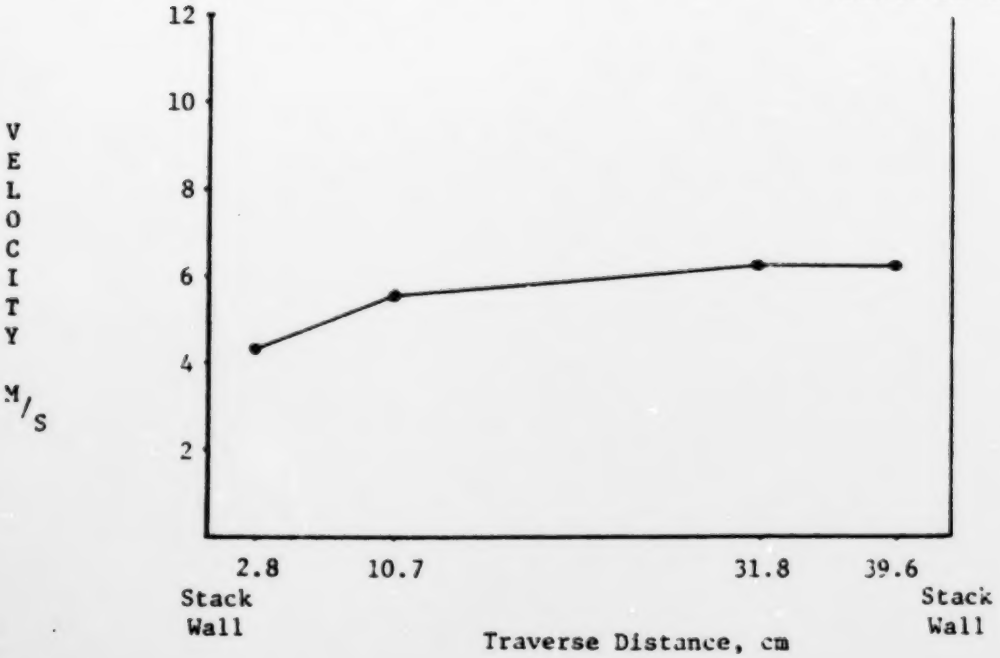
Wind 32 km/h South



Graph 5 . Velocity Profile of Test 3 , East Port.
Wind 16-32 km South




Graph 6 . Velocity Profile of Test 3 , South Port.
Wind 16-32 km South



# APPENDIX B: EQUIPMENT CALIBRATION DATA

## DRY GAS METER & ORIFICE METER CALIBRATION SHEET

Dry Gas Meter S/N 711030 (Bendix) — Calibrated re Large Wet Test Meter

Atmospheric Pressure 28.93 in Hg = 737.3 mm Hg — Calibrated by D. Fritz & A Schultz

Ambient Temperature 22.4°C — Date 840524

| Manometer Orifice ΔH (in. $H_2O$) | W.T.M. Volume Vw ($Ft.^3$) | Dry Gas Meter Reading Initial ($Ft.^3$) | Dry Gas Meter Reading Final ($Ft.^3$) | D.G.M. Volume Vd ($Ft.^3$) | Temperature W.T.M. Tw (°F.) | Temperature W.T.M. Tw (°C.) | Temperature D.G.M. Ti (°F.) | Temperature D.G.M. To (°F.) | Time t (Min.:Sec.) | Time t (Min.) | W.T.M. Manometer Δ H (in. $H_2O$) | Partial Pressure Ps (mm. Hg) | W.T.M.:D.G.M. Ratio γ | $\sqrt{\quad}$ (—) | Flowrate @ S.T.P. Qm ($Ft.^3$/min.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.500 | 5.0 | 401.645 | 406.667 | 5.042 | 71.8 | 22.2 | 106 | 82 | 12:51.50 | 12.858 | 0.40 | 20.070 | 1.019 | 0.569 | 0.785 |
| 0.495 | 5.0 | 406.995 | 411.935 | 4.990 | 71.9 | 22.2 | 107 | 83 | 12:53.93 | 12.899 | 0.43 | 20.070 | 1.015 | 0.567 | 0.785 |
| 0.505 | 5.0 | 412.209 | 417.212 | 5.003 | 72.0 | 22.2 | 107 | 84 | 12:48.59 | 12.810 | 0.36 | 20.070 | 1.013 | 0.573 | 0.787 |
| 1.00 | 5.0 | 418.212 | 423.225 | 5.013 | 72.0 | 22.2 | 110 | 85 | 9:04.31 | 9.072 | 0.50 | 20.070 | 1.013 | 0.807 | 0.547 |
| 1.00 | 5.0 | 424.630 | 429.643 | 5.009 | 72.0 | 22.2 | 111 | 86 | 9:04.91 | 9.082 | 0.50 | 20.070 | 1.013 | 0.808 | 0.547 |
| 1.00 | 5.0 | 430.134 | 435.155 | 5.021 | 72.0 | 22.2 | 116 | 86 | 9:04.86 | 9.081 | 0.50 | 20.070 | 1.017 | 0.808 | 0.548 |
| 1.50 | 5.0 | 436.817 | 441.849 | 5.032 | 72.0 | 22.2 | 115 | 86 | 7:26.59 | 7.443 | 0.60 | 20.070 | 1.014 | 0.989 | 0.667 |
| 1.50 | 5.0 | 442.457 | 447.540 | 5.037 | 72.1 | 22.3 | 115 | 87 | 7:26.81 | 7.447 | 0.60 | 20.193 | 1.012 | 0.990 | 0.668 |
| 1.50 | 5.0 | 448.147 | 453.191 | 5.044 | 72.1 | 22.3 | 115 | 87 | 7:24.95 | 7.416 | 0.60 | 20.193 | 1.011 | 0.990 | 0.670 |
| 2.00 | 5.0 | 454.234 | 459.280 | 5.046 | 72.2 | 22.3 | 115 | 87 | 6:22.58 | 6.381 | 0.63 | 20.193 | 1.009 | 1.142 | 0.770 |
| 2.00 | 5.0 | 460.292 | 465.337 | 5.045 | 72.2 | 22.3 | 115 | 88 | 6:29.72 | 6.495 | 0.60 | 20.193 | 1.010 | 1.143 | 0.766 |
| 2.02 | 5.0 | 465.553 | 470.601 | 5.048 | 72.3 | 22.4 | 115 | 88 | 6:29.58 | 6.493 | 0.62 | 20.316 | 1.009 | 1.149 | 0.766 |

Slope (K) = 0.6536

Coefficient of Determination ($r^2$) = 0.9994

$\bar{\gamma}$ = 1.011 ± 0.004

$\Delta H@$ = 2.151

Comments:

## DRY GAS METER & ORIFICE METER CALIBRATION SHEET

Dry Gas Meter S/N 711130 (Bendix) Calibrated re Large Wet Test Meter

Atmospheric Pressure 28.83 in Hg = 732.3 mm Hg Calibrated by D Fritz / A Shultz

Ambient Temperature 22.4°C Date 840524

| Orifice ΔH (in. $H_2O$) | W.T.M. Volume $V_w$ ($Ft.^3$) | Dry Gas Meter Reading Initial ($Ft.^3$) | Dry Gas Meter Reading Final ($Ft.^3$) | D.G.M. Volume $V_d$ ($Ft.^3$) | Temperature W.T.M. $T_w$ (°F.) | Temperature W.T.M. $T_w$ (°C.) | Temperature D.G.M. $T_i$ (°F.) | Temperature D.G.M. $T_o$ (°F.) | Time t (Min.:Sec.) | Time t (Min.) | W.T.M. Manometer Δ m (in. $H_2O$) | Partial Pressure $P_s$ (cm. Hg) | W.T.M./D.G.M. Ratio $\gamma$ (—) | $\sqrt{\quad}$ (—) | Flowrate @ S.T.P. $Q_m$ ($Ft.^3$/min.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.50 | 5.0 | 472.214 | 477.264 | 5.050 | 72.3 | 22.4 | 116 | 88 | 5:51.66 | 5.861 | 0.78 | 20.316 | 1.008 | 1.277 | 0.947 |
| 2.50 | 5.0 | 477.253 | 482.296 | 5.043 | 72.3 | 22.4 | 116 | 88 | 5:51.63 | 5.861 | 0.74 | 20.316 | 1.009 | 1.277 | 0.847 |
| 2.50 | 5.0 | 482.417 | 487.510 | 5.047 | 72.3 | 22.4 | 116 | 88 | 5:51.60 | 5.860 | 0.75 | 20.316 | 1.009 | 1.277 | 0.847 |
| 3.00 | 5.0 | 487.202 | 492.257 | 5.055 | 72.3 | 22.4 | 116 | 88 | 5:21.79 | 5.363 | 0.80 | 20.316 | 1.010 | 1.398 | 0.924 |
| 3.00 | 5.0 | 492.974 | 498.023 | 5.049 | 72.3 | 22.4 | 116 | 88 | 5:21.99 | 5.367 | 0.80 | 20.316 | 1.007 | 1.398 | 0.924 |
| 3.00 | 5.0 | 498.023 | 503.068 | 5.045 | 72.3 | 22.4 | 116 | 88 | 5:21.86 | 5.364 | 0.76 | 20.316 | 1.008 | 1.398 | 0.924 |
| 4.00 | 6.0 | 503.563 | 509.563 | 6.050 | 72.3 | 22.4 | 116 | 89 | 5:31.60 | 5.527 | 0.85 | 20.316 | 1.007 | 1.614 | 1.075 |
| 4.00 | 6.0 | 514.105 | 520.185 | 6.040 | 72.3 | 22.4 | 116 | 89 | 5:31.59 | 5.527 | 0.85 | 20.316 | 1.008 | 1.614 | 1.075 |
| 4.00 | 6.0 | 531.034 | 537.107 | 6.052 | 72.3 | 22.4 | 117 | 89 | 5:31.09 | 5.518 | 0.85 | 20.316 | 1.007 | 1.614 | 1.077 |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

Linear Regression: Intercept (b) 0.017

Slope (m) 0.6536

Coefficient of Determination ($r^2$) 0.9994

$\bar{\gamma}$ = 1.011 ± 0.004

$\Delta H@$ = 2.151

Comments:

8245 Rev. 1/25/83 JT/ca

## S-TYPE PITOT TUBE CALIBRATION

PROBE SIZE (ft) 3 — CALIBRATION # 84-22

PROBE LINER SS — DATE April 9/84

PROBE MANUFACTURER RAC — BAROMETRIC PRESSURE (Hg) 29.20

TIP SIZE (inches) 0.500 — AMBIENT TEMP. (°C) 18.6

TIP TYPE SS — OPERATOR KR

STACK THERMOCOUPLE ☒ PRESENT

☐ ABSENT

### HP 97 INPUT/OUTPUT

| | | |
|---|---|---|
| Temp | 18.6 | °c |
| Bar. Press | 29.20 | In. Hg |
| Scale Factor | 0.1 | |

| | | |
|---|---|---|
| 1.50 | Δ p (std) | |
| 26.008375 | | |
| 2.32 | Δ p (s-pitot) | |
| 0.802074 | | |
| 26.013825 | | |

| | | |
|---|---|---|
| 3.46 | Δ p (std) | |
| 39.500777 | | |
| 5.42 | Δp(s-pitot) | |
| 0.796987 | | |
| 39.509055 | | |

| | | |
|---|---|---|
| 0.16 | Δ p (std) | |
| Tunnel Velocity 8.494300 | ft/sec | |
| 0.26 | Δ p (s-pitot) | |
| Cp, at this 0.782503 | velocity | |
| Tunnel Velocity 8.496080 | (using Cp) | |

| | | |
|---|---|---|
| 1.98 | Δ p (std) | |
| 29.881348 | | |
| 3.08 | Δ p (s-pitot) | |
| 0.799771 | | |
| 29.887610 | | |

| | | |
|---|---|---|
| 4.10 | Δ p (std) | |
| 42.999115 | | |
| 6.38 | Δp(s-pitot) | |
| 0.799640 | | |
| 43.008126 | | |

| | | |
|---|---|---|
| 0.62 | Δ p (std) | |
| 16.721046 | | |
| 0.98 | Δ p (s-pitot) | |
| 0.793406 | | |
| 16.724550 | | |

| | | |
|---|---|---|
| 2.38 | Δ p (std) | |
| 32.760918 | | |
| 3.72 | Δ p (s-pitot) | |
| 0.797866 | | |
| 32.767784 | | |

| | |
|---|---|
| 0.795978 | Cp (ave) |
| 0.005826 | Std. Dev. |
| 8 | Deg. of Freedom |

| | | |
|---|---|---|
| 0.98 | Δ p (std) | |
| 21. 022319 | | |
| 1.55 | Δ p (s-pitot) | |
| 0.793159 | | |
| 21.026725 | | |

| | | |
|---|---|---|
| 2.87 | Δ p (std) | |
| 35.975640 | | |
| 4.48 | Δ p (s-pitot) | |
| 0.798390 | | |
| 35.983180 | | |

| | |
|---|---|
| 2.306 | t .05 |
| 0.791500 | Low Cp |
| 0.795978 | Mean Cp |
| 0.800457 | High Cp |

rev. 82-01

# APPENDIX C: FIELD DATA SHEETS

## FIELD DATA SHEET

**Plant** Cara Airline Services **Location** Winnipeg International Airport

**Stack** Incinerator **Test number** 1 **Date** May 29, 1984

**Ambient temperature (°F)** 68 **Barometric pressure (in. Hg)** 29.49 **Time** 10:30 A.M. to 11:24 A.M.

**Nozzle diameter (in.)** 0.495 **Probe length/type** 3 feet/stainless steel **Stack static pressure (in. $H_2O$)** +0.045

**Probe temperature (°F)** 206 to 413 **Filter holder temperature (°F)** 252 to 297 **Leak check** 0.015 **CFM @** 13 **" Hg Vacuum**

| Traverse point number | Clock time, start | Stack gas temperature, °F | Gas meter volume, cu. ft. | Velocity pressure, in. $H_2O$ | Orifice pressure drop in. $H_2O$ | Gas meter temperature, °F | | Final impinger Temperature, °F | Pump vacuum in. $H_2O$ | Isokinetic factor, % |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Inlet | Outlet | | | |
| East 1 | 0 | 988 | 2.258 | 0.035 | 0.740 | 68 | 68 | 63 | 4 | 103.1 |
| 2 | 5 | 1053 | 2.580 | 0.048 | 0.978 | 86 | 68 | 53 | 5 | 101.9 |
| 3 | 10 | 1180 | 2.870 | 0.065 | 1.199 | 93 | 71 | 56 | 6 | 100.2 |
| 4 | 15 | 1101 | 2.880 | 0.060 | 1.189 | 97 | 74 | 60 | 6 | 101.3 |
| | | | | | | | | | | |
| South 1 | 20 | 958 | 2.160 | 0.030 | 0.665 | 80 | 80 | 64 | 4 | 100.4 |
| 2 | 25 | 1046 | 2.595 | 0.045 | 0.941 | 96 | 80 | 58 | 5 | 103.1 |
| 3 | 30 | 1075 | 2.925 | 0.060 | 1.217 | 101 | 80 | 57 | 6 | 101.1 |
| 4 | 35 | 1072 | 2.980 | 0.060 | 1.224 | 102 | 80 | 59 | 6 | 103.3 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Average or total | 40 | 1059 | 21.248 | 0.050 | 1.019 | -- | -- | -- | -- | 101.8 |

## FIELD DATA SHEET

Plant Cara Airline Services Location Winnipeg International Airport

Stack Incinerator Test number 2 Date May 29, 1984

Ambient temperature (°F) 78 Barometric pressure (in. Hg) 29.49 Time 12.35 P.M. to 1:24 P.M.

Nozzle diameter (in.) 0.495 Probe length/type 3 feet/stainless steel Stack static pressure (in. $H_2O$) +0.045

Probe temperature (°F) 256 to 432 Filter holder temperature (°F) 285 to 353 Leak check 0.015 CFM @ 13 " Hg Vacuum

| Traverse point number | Clock time, start | Stack gas temperature, °F | Gas meter volume, cu. ft. | Velocity pressure, in. $H_2O$ | Orifice pressure drop in. $H_2O$ | Gas meter temperature, °F | | Final impinger Temperature, °F | Pump vacuum in. $H_2O$ | Isokinetic factor, % |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Inlet | Outlet | | | |
| East 1 | 0 | 961 | 2.548 | 0.040 | 0.896 | 88 | 86 | 60 | 5 | 103.4 |
| 2 | 5 | 1055 | 2.740 | 0.048 | 1.010 | 103 | 87 | 55 | 6 | 103.4 |
| 3 | 10 | 1096 | 2.880 | 0.055 | 1.116 | 108 | 88 | 57 | 6 | 102.8 |
| 4 | 15 | 1072 | 3.042 | 0.060 | 1.252 | 108 | 89 | 58 | 7 | 103.0 |
| | | | | | | | | | | |
| South 1 | 20 | 1103 | 2.281 | 0.053 | 0.719 | 82 | 83 | 56 | 4 | 104.3 |
| 2 | 25 | 1165 | 2.640 | 0.071 | 0.970 | 97 | 83 | 52 | 5 | 102.2 |
| 3 | 30 | 1178 | 2.777 | 0.078 | 1.054 | 100 | 84 | 54 | 6 | 102.6 |
| 4 | 35 | 1158 | 2.950 | 0.086 | 1.168 | 99 | 85 | 56 | 6 | 103.5 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Average or total | 40 | 1099 | 21.858 | 0.061 | 1.023 | -- | -- | -- | -- | 103.2 |

## FIELD DATA SHEET

Plant Cara Airline Services Location Winnipeg International Airport

Stack Incinerator Test number 3 Date May 29, 1984

Ambient temperature (°F) 80 Barometric pressure (in. Hg) 29.49 Time 2:28 P.M. to 3:19 P.M.

Nozzle diameter (in.) 0.495 Probe length/type 3 feet/stainless steel Stack static pressure (in. $H_2O$) +0.045

Probe temperature (°F) 200 to 479 Filter holder temperature (°F) 220 to 376 Leak check 0.010 CFM @ 14 " Hg Vacuum

| Traverse point number | Clock time, start | Stack gas temperature, °F | Gas meter volume, cu. ft. | Velocity pressure, in. $H_2O$ | Orifice pressure drop in. $H_2O$ | Gas meter temperature, °F | | Final impinger Temperature, °F | Pump vacuum in. $H_2O$ | Isokinetic factor, % |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Inlet | Outlet | | | |
| East 1 | 0 | 970 | 2.178 | 0.030 | 0.647 | 84 | 84 | 60 | 4 | 102.7 |
| 2 | 5 | 1138 | 2.415 | 0.040 | 0.819 | 100 | 86 | 55 | 4 | 104.3 |
| 3 | 10 | 1209 | 2.860 | 0.060 | 1.149 | 103 | 86 | 54 | 5 | 102.3 |
| 4 | 15 | 1214 | 2.762 | 0.050 | 1.034 | 104 | 86 | 57 | 5 | 103.5 |
| | | | | | | | | | | |
| South 1 | 20 | 1049 | 1.958 | 0.025 | 0.523 | 89 | 86 | 67 | 4 | 103.6 |
| 2 | 25 | 1074 | 2.435 | 0.040 | 0.833 | 105 | 88 | 61 | 5 | 101.8 |
| 3 | 30 | 1093 | 2.720 | 0.050 | 1.023 | 107 | 88 | 61 | 5 | 102.2 |
| 4 | 35 | 1095 | 2.747 | 0.050 | 1.020 | 108 | 88 | 62 | 5 | 103.4 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Average or total | 40 | 1105 | 20.075 | 0.043 | 0.881 | -- | -- | -- | -- | 103.0 |

APPENDIX D: ANALYTICAL REPORT

RAIL WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

SUBMITTER: KEVIN REEVE APC.
LOCATION: CARA OPERATIONS LTD.
REPORT TO: K. REEVE
STACK EMISSIONS ER-1

SAMPLE - ID From: SV 6946A To: SV 09972

L – Less than
G – Greater than

Date Sampled: SM 25 25 Date Received: SM 25 31

| Sample Number | Identification or Comments | Parameter | L/G | Value | Units | Date Analyzed |
|---|---|---|---|---|---|---|
| | Run #3. | | | | | |
| 9964 | 1. Bottle #1. | TSP | | .0153 | g | SM 06 16 |
| 9965 | 2. Bottle #2. | TSP | | .0083 | g | SM 06 11 |
| 9966 | 3. Filter #393 | TSP | | .0243 | g | SM 06 16 |
| | Run #2 | | | | | |
| 9967 | 1. Bottle #1 | TSP | | .0201 | g | SM 06 11 |
| 9968 | 2. Bottle #2. | TSP | | .0052 | g | SM 06 11 |
| 9969 | 3. Filter #392 | TSP | | .0345 | g | SM 06 16 |
| | Run #1. | | | | | |
| 9970 | 1. Bottle #1. | TSP | | .0253 | g | SM 06 11 |
| 9971 | 2. Bottle #2. | TSP | | .0098 | g | SM 06 11 |
| 9972 | 3. Filter #391 | TSP | | .0342 | g | SM 06 16 |